THE OPERATIONAL IMPACT OF MOBILITY READINESS SPARES PACKAGE CONFIGURATION DURING OPERATION IRAQI FREEDOM

THESIS

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Abstract

Utilizing the Aircraft Sustainability Model (ASM), Air Force logisticians must determine the best possible number and mix of spares and repair parts for each deployable readiness spares package, better known as a mobility readiness spares package (MRSP). By analyzing MRSP support for Operation IRAQI FREEDOM (OIF), Air Force leadership can have a current picture of MRSP operational effectiveness and mission support capabilities. This research focused on determining the current configuration of MRSPs for OIF by selecting a representative array of MRSPs and supported weapon systems actively involved in OIF, and obtaining relevant support effectiveness measures. Measures selected for analysis were MRSP fill rate, stockage effectiveness, issue effectiveness, mission capable spares rate, and total requirements variance. An analysis of MRSPs for the E-3B, F-16C, and HC-130P aircraft revealed varying levels of effectiveness when compared with overall contingency and supply chain metrics.

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Table of Contents

Page

Page

List of Figures

List of Tables

THE OPERATIONAL IMPACT OF MOBILITY READINESS SPARES PACKAGE CONFIGURATION DURING OPERATION IRAQI FREEDOM

I. Introduction

Background

According to AFMAN 23-110, Volume I, Part 1, Chapter 14, *Readiness Spares Packages (RSP) and High Priority Mission Support Kits (HPMSK)*, the objective of the readiness spares package (RSP) program is "to support national strategy in consonance with the guidance issued by the Office of the Secretary of Defense. Specifically, the Air Force objective is to authorize, acquire on time, preposition, prestock, and maintain in a serviceable condition ready for use, all RSP needed to support the wartime activities specified in the War and Mobilization Plan (WMP)" (DAF, 2004:Ch. 14, 6). Utilizing the Aircraft Sustainability Model (ASM), a mathematical tool based on the Dyna-METRIC model, Air Force logisticians must determine the best possible number and mix of spares and repair parts for each deployable RSP, better known as a mobility readiness spares package (MRSP). Each MRSP is designed for a "worst case scenario", to support a weapon system in a contingency environment for 30 days with no resupply. With this objective in mind, regulations also require that "items and quantities in RSPs will, in all cases, be the minimum necessary to support major command required missions as reflected in WMP tasking" (DAF, 2004:Ch. 14, 6).

The operational environment of the Air Force has significantly changed since the end of the Cold War. The concept of all-out, full-scale war is no longer applicable when

determining deployment support. Instead, most of today's war fighting consists of small contingencies for relatively short periods of time. Instead of requiring a full-scale forward deployment of forces, war fighting is a surge from peace-time support to contingency support. Recently, the Secretary of Defense defined this as a change from requirements-driven force development to a capabilities-based approach.

> In the past, the construct of force development was requirements-driven based upon specific threats. However, the United States cannot predict with confidence the nations, combinations of nations, or non-state actors that may pose threats to its interests, allies or friends. To mitigate the risk of this uncertainty, the United States must anticipate the range of broad capabilities that any adversary might employ and the necessary capabilities required to resolve any conflict or crisis. Thus, a capabilities-based approach shifts this construct from threat-based force development to force planning based on a set of desired capabilities for any given military operation. (DoD, 2003:3)

One way Air Force leadership responded to this change in operational environment was by reorganizing into ten Aerospace Expeditionary Forces (AEF) in 1999. Linked to one of two Air Force Expeditionary Wings (AEW), and crafted to meet the needs of a regional commander, each AEF "includes approximately 175 aircraft and 20,000 people from both the active and reserve components" (O'Rourke, 2003:28). The AEF structure brings two important components to the deployment arena. First is predictability. Although it is still not possible to predict exactly when a contingency will occur, AEF forces "rotate on a 15-month training and deployment cycle, during which they may be deployed for up to 90 days" (O'Rourke, 2003:28). The second is speed. Whereas it might take several days to prepare an entire squadron or wing to deploy, the new structure ideally provides the ability "to deploy an AEF in 48 hours and up to five AEFs within 15 days" (O'Rourke, 2003:28). This new operational strategy created "an organizational structure and rotational deployment schedule that would permit the Air

Force to effectively meet worldwide contingency demands without placing undue strains on equipment and personnel" (O'Rourke, 2003:28).

Although Air Force leadership has responded to the changes in operational environment, the support structure of the MRSP has remained the same. The current method of MRSP development and administration, as required by the WMP-5, has changed little from the Cold War threat assessment policy. It would stand to reason that MRSP support should be tailored to meet each specific threat as a rule, not the exception. A 2000 Department of Defense report to Congress on challenges faced during Operation ALLIED FORCE in Kosovo indicated a disconnect between the way MRSPs are configured and the way contingency operations actually unfold.

> Present day U.S. Air Force Mobility Readiness Spares Package (MRSP) levels reflect the projected demands for a scenario involving two nearly simultaneous major theater wars and rely heavily on the availability of deployed aircraft that can be cannibalized for spare parts to offset MRSP shortfalls. Cannibalization is the primary source of many parts not carried in present fighter MRSPs. When these MRSPs are used to support a partial squadron deployment (split-based operations), stay behind (home station) aircraft must be cannibalized to fill spares shortfalls of the deployed element, since there are not enough aircraft deployed to meet spares (cannibalization) requirements. The lower than planned aircraft loss rates and higher aircraft availability rates experienced in OAF exacerbated this problem by increasing the demand for spares while further limiting the availability of cannibalization aircraft.
>
> Our experience in Operation Allied Force provided indication that current Air Force Mobility Readiness Spares Packages may be insufficient to achieve aircraft availability targets under the Air Force's Air Expeditionary Force (AEF) concept. For AEF commitments, the Air Force may not deploy entire squadrons, creating split-based operating conditions not unlike those experienced during Allied Force. (DoD, 2000:101)

This report highlights the importance of effective MRSP support in a contingency operation. Recent wartime operations in support of Operation IRAQI FREEDOM (OIF)

provided an excellent opportunity to examine the current operational effectiveness of MRSPs. Air Force leadership should know whether the theoretical models they rely on to provide accurate assessments of wartime scenario requirements are providing information and inputs that lead to mission success.

Problem Statement

Air Force leadership recognizes that the need for efficient and effective MRSP support in contingency operations is critical to weapon system and Air Force mission success. By analyzing MRSP support for OIF, the Air Force can get a current picture of MRSP operational effectiveness and mission support capabilities.

Research Question

The main focus of this research was to answer the research question, "What was the effect of MRSP configuration on current Air Force contingency operations support?". By understanding the impact of MRSPs on weapon system availability during Operation IRAQI FREEDOM, the Air Force may wish to explore alternatives to the current method of contingency support that more closely reflect current operational environment requirements.

Investigative Questions

In order to properly direct the research and answer the research question, the following investigative questions and sub questions were explored.

1. How were MRSPs configured for OIF?
2. Did MRSPs effectively support the weapon systems during the first 30 days of operations?

a. Did the MRSPs have *enough* spares for aircraft maintenance personnel to keep aircraft mission capable? In other words, did we take what was needed to the conflict?

b. Did the MRSPs have the *right* spares for aircraft maintenance personnel to keep aircraft mission capable? In other words, did we need what we took to the conflict?

Scope

The Air Force used 863 aircraft and 29 weapon systems, either deployed to or in support of OIF (USCENTAF, 2003:6). This research was limited to examining the spares support provided by three different MRSPs for three different deployed weapon systems, the E-3B, F-16C, and HC-130P. MRSP selection was further limited to single units of each weapon system and one location for each weapon system.

Methodology

The methodology of this research focused on three main objectives. The first was to determine the configuration of MRSPs for OIF and whether they mirrored the actual authorizations as dictated by the WMP, Volume 5 (WMP-5). The second objective was to select for analysis a representative array of MRSPs and supported weapon systems actively involved in supporting Operation IRAQI FREEDOM from contingency locations. The last objective was to obtain and analyze relevant support effectiveness data for the first 30 days of OIF (19 March – 17 April 2003).

Summary

This chapter has provided background for the thesis topic and the questions that the research will attempt to answer. Chapter two is a literature review that will explain thesis related concepts and discuss previous works related to the thesis topic. Chapter

three will explain the methodology used in collecting, analyzing and reporting the results of the data. Chapter four will present the results of the data collection. Finally, Chapter five will discuss conclusions and observations drawn from the results, as well as any future research opportunities.

II. Literature Review

Chapter Overview

The purpose of this chapter is to provide background on understanding the two main aspects of the research objective: how are MRSPs currently configured, and what criteria can be used to determine MRSP effectiveness. This chapter will also introduce and examine previous studies on MRSP performance during contingency operations.

MRSP Characteristics

Chapter 14.32 of AFMAN 23-110 outlines the basic components of MRSP configuration:

> Required quantities for individual items in RSPs are computed in the D087G System. ASM is the mathematical tool used for the computation. It is based largely on the Dyna-METRIC pipeline model…The requirement computation does not attempt stockage to achieve 100 percent mission capability, since that is neither economically practical nor statistically feasible. The goal instead is expressed as the number of aircraft required, called the DSO, or as its inverse, the NMCS target. (DAF, 2004:Ch. 14, 23)

It is now necessary to discuss these factors that contribute to the MRSP computation—the Dyna-METRIC pipeline model, the Aircraft Sustainability Model (ASM), the Direct Support Objective (DSO) and the Requirements Execution Availability Logistics Module (D087G).

Dyna-METRIC Pipeline Model

The Dyna-METRIC mathematical statistical model was developed by the Rand Corporation as a tool for "studying the transient behavior of component repair/inventory systems under time-dependent operational demands and logistics decisions like those that might be experienced in wartime" (Sherbrooke, 1992:184). There are both analytical and

simulation versions of the model. The simulation model can provide an assessment of how a given set of spares will perform under a certain logistics scenario. The analytical model can do two things: compute aircraft availability based on spares levels, or compute spares levels based on aircraft availability. The Dyna-METRIC model is a stochastic, multi-item, multi-location, multi-echelon, multi-indenture system for dynamic demand scenarios with the ultimate goal being maximization of aircraft availability (Anderson, 2003:6-5). The model requires recognition of several key assumptions:

- Demands arrive randomly with a known mean and variance according to either a Poisson or negative binomial distribution
- Line replaceable unit (LRU) demand is proportional to either flying hours or sortie rate
- Demand and service process times are independent
- Repair and transportation times have a known probability distribution with either an exponential or deterministic mean
- Repair times vary by component and transportation times vary by base
- There is unconstrained repair capability
- There is no lateral resupply for the deployed weapon system
- All aircraft deployed to a single location are identical
- Cannibalization from other aircraft is allowed with spares consolidation on as few aircraft as possible
- Cannibalization is done on the entire LRU (Anderson, 2003:6-6)

In addition to being the backbone of the Aircraft Sustainability Model, the Dyna-METRIC model has also been incorporated into two other Air Force systems: the Sustainability Assessment Model (SAM) and the Dyna-METRIC Microcomputer Analysis System (DMAS). Both systems, with both sortie and aircraft availability

estimation capabilities, can provide a unit or theater level assessment of combat readiness (DAF, 2004:Ch. 14, 51).

Aircraft Sustainability Model

The Logistics Management Institute (LMI) developed the Aircraft Sustainability Model (ASM) specifically for the Air Force to "compute [an] optimal spares mix to support a wide range of possible operating scenarios" (Slay et al, 1996:iii). The goal of the ASM is the same as that of the analytical Dyna-METRIC model--to maximize aircraft availability. However, it also factors in the purchase cost of spares required to reach a desired aircraft availability goal over a specific coverage period. The ASM has the same assumptions as the Dyna-METRIC model, but it also allows for the inclusion of different operational goals and constraints, as well as weapon system component characteristics in the spares mix computation.

> Military planners must calculate spares requirements to support weapon system readiness over a wide range of possible situations. Using the operational parameters of those situations and the characteristics of the weapon system's components—including projected failure rates, repair times, and procurement costs—the ASM computes cost-effective spares mixes to minimize waiting time for spare parts. (Slay et al, 1996:1-1)

Although aircraft availability and purchase cost are the major factors, there are seven other factors that are considered in the ASM.

- Item type (reparable item vs. consumable item)
- Indenture structure (LRU vs. SRU)
- Operating environment (dynamic vs. steady state)
- Common items (items common to more than one aircraft series or type)
- Cannibalization (allowing consolidation of broken spares on a single aircraft)

- Item stock considerations (include existing/back ordered items)
- Other factors (item specific factors to include item failure rates, repair times, quantity per application and lead time) (Kline et al, 2002:1-3)

By incorporating additional variables, the ASM assessment analysis gives logistical planners a broader view than would be available from considering just cost and aircraft availability.

> The ASM then uses a marginal analysis approach, ranking possible additions to the inventory in terms of their probable benefit to aircraft availability divided by their procurement cost. Spares that have the greatest benefit per dollar appear at the top of this "shopping list". Accumulated costs and resulting aircraft availability are tracked as the shopping list is formed to provide a curve relating overall funding and projected availability. (Slay et al, 1996:iv)

The ability of the ASM to create this "shopping list" that lies along a cost curve, as seen in Figure 1 (Kline et al, 2002:1-1), gives military logisticians two ways to consider which spares to purchase: they can either use a budget constraint to purchase a maximum level of projected aircraft availability, or determine budget requirements by selecting a desired level of aircraft availability. In stocking MRSPs, the latter method is used. The aircraft availability level used in the ASM is called a direct support objective.

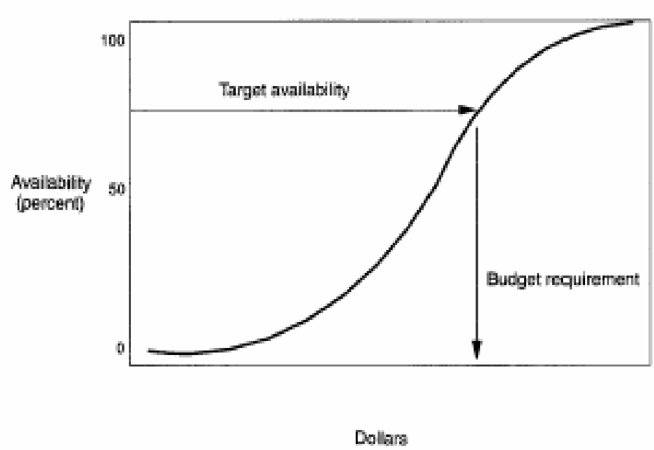

Figure 1. Availability vs. Cost Curve

Direct Support Objective

The direct support objective (DSO) is "the point in the spares computation at which sufficient quantities are available to support the sorties of the unit's wartime tasking" (DAF, 2004:Ch. 14, 23). In other words, it is the minimum number of fully mission capable aircraft required at the end of the support period. DSOs can vary by aircraft type and mission. Fighter aircraft are allowed to use dual DSOs, one for the "surge period" or the beginning of the contingency when aircraft usage and breakage is at its peak, and another for the remaining "support period". The DSO is generally computed by multiplying the number of primary aircraft required for the mission (PMAI) by a specific percentage. Table 1 lists the percentages used to formulate the DSO (DAF, 2004:Ch. 14, 23).

Table 1. Percentages for Computing the DSO

Special Operation	83%
Tactical Airlift	83%
Strategic Airlift	93%
Helicopters	83%
E-3, E-4, E-8	83%
Bombers (including F-117)	83%
Tankers	83%
Fighters (default minimum)	83%

Dual DSOs for fighter aircraft can be computed using a different formula, so long as the result is not less than the default minimum listed above. Each DSO is computed

using the PMAI, the desired sortie rate, the maximum turn rate, and the number of spare aircraft available to perform the mission:

DSO = PMAI * SORTIE RATE/MAX TURN RATE + # of spare aircraft

The inverse of the DSO (1 – DSO), called the non-mission capable supply (NMCS) target, is the number used in the ASM as the aircraft availability portion to determine the optimal number of spares for the MRSP within the designated constraints in addition to cost.

D087G System

The D087G system is formally known as the classified portion of the Requirements Execution Availability Logistics Module (REALM) in the Weapon System Management Information System (WSMIS). Using the ASM, The D087G and D087H (unclassified) systems "support the development and maintenance of RSPs, compute the item requirements to support unit taskings, and provide the basis for buy and repair budgeting in support of RSPs" (DAF, 2004:Ch. 14, 24). Spares requirements used in the D087G come from the Minimum Essential Subsystem List (MESL) for the weapon system, a listing of subsystems that, when broken, would generate a non-mission capable grounding condition (DAF, 2004:Ch. 14, 7).

MRSP Effectiveness

Before evaluating the effectiveness of MRSPs during Operation IRAQI FREEDOM (OIF), it was important to know what constitutes a healthy or effective MRSP. MRSP contingency effectiveness literature was found in two general areas: evaluating MRSP performance for the entire duration of a contingency, not just the initial

30 day support period; or evaluating aggregate MRSP composition and performance across weapon systems. A discussion of some of those writings is at the beginning of this section.

There has recently been a surge in military supply chain effectiveness literature. If one looks at an MRSP as a portable warehouse with limited stock and a dedicated retail customer-base, one can easily accept it as a very compact supply chain. A decision was made to define MRSP effectiveness by using select elements found in the literature that constitute an effective supply chain. This section concludes with a discussion of those writings and what the authors believe are the most critical measures for supply chain managers to watch.

Operation IRAQI FREEDOM

In January 2004, the Plans and Programs directorate of Air Force Material Command headquarters (HQ AFMC/XP) generated a presentation for internal AFMC logistics management titled *Analysis of Deployment Kits for Operation IRAQI FREEDOM*. The author looked at the aggregated total of 84 MRSPs for 17 different weapon systems and compared the actual demands during the first 30 days of the operation with the actual MRSP spares inventories as computed by the ASM. The key elements of evaluation were under prediction and over prediction of item usage from three different angles: range (stock-numbered items); depth (line item totals); and cost. Analysis showed over prediction of items far outweighed under prediction, both in range and depth, at a cost of over $240 million (Woodrum, 2004:9-10). Further analysis showed a cost difference between the two item categories. The majority of the top ten under predicted items were higher cost items, ranging from $22K to $626.3K.

Conversely, the majority of the top ten over predicted items were much lest costly, ranging in cost from $209 to $7.3K (Woodrum, 2004:13). Woodrum hypothesized on the range between the demand and cost of over-predicted items.

> While over-predicted demands were six times that of under-predicted demands, the same is not true with demand costs. The cost of over-predicted demands was three times that of the cost of under-predicted items. This could mean a lot of the items being over-predicted are low cost items. (Woodrum, 2002:16)

Woodrum's broad analysis of MRSP performance showed there is a definite gap between what is taken in a MRSP and what is actually used from it during the initial 30 days of a contingency. However, by looking at effectiveness across multiple MRSPs for multiple weapon systems, the only measures suitable for such an aggregation were general item usage and total cost. Woodrum was unable to look at other effectiveness measures that would be revealed by analyzing performance at a lower level of aggregation. The next two reports also offer analyses of MRSP effectiveness for multiple MRSPs, but only for a single weapon system.

Operation ALLIED FORCE

In April 2000, two Air Command and Staff College graduate research reports focused on MRSP support during Operation ALLIED FORCE (OAF) in Kosovo. Two different weapon systems, the KC-135 and the E-3, were examined using different readiness indicators to determine successful weapon system support.

In the report *Examination of E-3 AWACS Readiness Spares Kit Adequacy During Operation Allied Force*, David McCormick focused two indicators. The first readiness indicator was the aggregate totals of mission-capable rates for the entire weapon system inventory throughout 1999 compared to those incurred during the 78-day conflict. The

second readiness indicator was average annual RSP fill rates, also for the entire weapon system inventory. McCormick concluded that E-3 MRSP performance was artificially boosted for two reasons. First, the E-3 fleet has an activity called the Sentry Control Point. Located at Tinker Air Force Base, its primary function is “to provide a single point of providing and coordinating positive logistical support for the widely dispersed E-3 fleet” (McCormick, 2000:10). Second, the NATO E-3 system at Geilenkirchen Air Base, which did not operate under a lean logistics approach, maintained high levels of spares from which U.S. E-3 supply personnel were able to borrow (McCormick, 2000:15). According to McCormick, “the bigger challenge is not in designing MRSPs, but rather keeping them stocked to authorized levels” (McCormick, 2000:18).

In the report *Improving Wartime Spares Support to AMC: An Analysis of KC-135 Readiness Spares Packages During Operation Allied Force With a Look to the Future and Support of the Aerospace Expeditionary Force*, Jon Larvick examined four customer service measures—fill rate, stockage effectiveness, issue effectiveness, and aircraft availability—to analyze MRSP support for the entire OAF duration. Larvick concluded that high stockage and issue effectiveness rates, boosted by expedited depot response for both repairs and backorders, were able to offset initially low fill rates (Larvick, 2000:22). However, the final aircraft availability rate of 77% was less than the 83% expected rate. Larvick was unable to provide any comprehensive data for this lower rate, but he argued that initial MRSP fill rate, extended sortie durations due to tanker basing locations, and higher than expected tanker usage rates contributed to the lower rate (Larvick, 2000:19-20).

While both of these research papers addressed MRSP effectiveness in terms of customer support, the focus was on MRSP support during the entire 78-day period of the campaign. Also, both scenarios relied on resupply and other spares support throughout the operation. Finally, both researchers focused on aggregate fleet performance. MRSPs are designed to meet a DSO for a specific PMAI for the first 30 days of a conflict without resupply. By focusing on this limited period of time and limited number of aircraft, a truer picture of MRSP support could be formulated.

One customer support metric looked at by both Larvick and McCormick was total weapon system aircraft availability at the end of the conflict. Although aircraft availability is widely considered to be the ultimate goal of any Air Force supply chain, neither researcher was able to definitively tie the other support metrics used to aircraft availability. The scope of this research is also limited in its ability to provide such a link. However, there is a body of literature that defines the measures and metrics logistics leaders should be watching and analyzing to ensure aircraft availability goals are met.

Logistics Management Institute

Several years ago, Department of Defense (DoD) leadership recognized a problem with supply process measurements.

> Performance measures, or "metrics," are used to monitor the progress of supply chain initiatives. However, a consensus in DoD considers the metrics available to senior DoD managers to be inadequate or lacking the depth to measure the effectiveness of the DoD supply chain. The metrics are not "balanced" across customer service, cost, readiness, and sustainability performance objectives. (Klapper et al, 1999:1-1)

At the request of the DoD, The Logistics Management Institute (LMI) developed nine metrics that provided a "balanced scorecard" or meaningful measurements balanced

across the three key supply chain objectives; customer satisfaction, cost, and readiness and sustainability.

- Perfect order fulfillment – aggregation of measures the customer considers important (on time, right quantity, acceptable quality, adequate paperwork)
- Supply chain response time – total length of the supply chain measured in days
- Percent change in customer price compared to inflation – compares how well procurement initiatives are keeping prices low with overall supply chain management efficiency
- Supply chain management costs as a percent of sales (at standard price) – all costs associated with operating a supply chain as a percent of the value of the assets moving through it
- Weapon system logistics costs as a percent of the acquisition price – captures costs reductions created by reliability and maintainability improvements
- Inventory Turns – measures productivity of the inventory investment and efficiency of the supply chain
- Weapon system not mission capable (NMC) rates – percent of time a weapon system fleet is NMCS, NMCM, or both
- Upside production flexibility – number of days needed to achieve a sustainable increase to support a two-major theater war scenario
- War reserve ratio – measures the ratio of on-hand war reserve assets to the war reserve requirement (Klapper et al, 1999:1-3)

These performance measures are at the DoD logistics system level. The next sections detail efforts at the Air Force level to define measures used in determining Air Force supply chain effectiveness.

Air Force Logistics Management Agency

In 2000, the Director of Supply (AF/IL) tasked the Air Force Logistics Management Agency (AFLMA) to “develop a set of performance measures or metrics

that represent the health of supply at an aggregate level" (Manship, 2001:1) after recognizing there were problems with the supply process measurement process.

The measurements AFLMA developed were designed to address three key problems. First, there was a lack of systems perspective that encouraged the making of inventory reduction decisions without considering the tradeoff for weapon system availability or mission capability rates. Next, there was too much emphasis on "secondary metrics" with no link to the primary AF goal of aircraft availability. Finally, there was a lack of information for supply chain managers to make tradeoff decisions between buy and repair actions with limited funding allocated to reach an aircraft availability goal (Manship, 2001:1).

In 2000, AFLMA developed 26 AF/IL approved aggregate metrics that determine how well a supply system is performing (Manship, 2001:10). These performance measures are focused on one key output measure—aircraft availability, at both the unit and Air Force level. Although there are 26 specific metrics, there are eight key process areas that they represent.

- Repair Effectiveness – identifies the ability to repair to meet needs and near term future support
- Buy Effectiveness – identifies the accuracy of buying what is needed to meet the worldwide demand
- Stockage/Distribution Effectiveness – identifies excess assets and customer support timeliness
- System Effectiveness – identifies data system and data integrity problems
- Manning Effectiveness – measures supply manning levels and identifies assigned vs. authorized shortages
- Sales Effectiveness – measures sales compared to forecasted requirements

- Funding Effectiveness – compares cost per flying hour requirements against both D200A (Requirements Management System) requirements and available funding
- DLA Responsiveness – measures supply availability through issue and stockage effectiveness and aircraft grounding (MICAP) incidents and hours based on commodity and by base (Manship, 2001:8-26)

These aggregate metrics proposed by AFLMA provide a "set of corporate AF supply measures that link each segment of supply to the corporate AF goals" (Manship, 2001:3). They do not provide, however, a range of performance values against which to measure effectiveness. The next section describes AFMC efforts to provide both.

Air Force Material Command

In 2003 Air Force Material Command (AFMC) published the *AFMC Supply Chain Metrics Guide* as an official reference guide for supply chain management to use to "transform a seemingly limitless amount of data into meaningful and useful measurements to guide sustainment operations" (Koenig, 2003:4). As do LMI and AFLMA, AFMC recognizes the link between meaningful measurements and process/performance improvement.

> This guide illustrates the metric linkage to AFMC supply processes and identifies business rules, targets, algorithms, reporting standards, evaluation methods and follow-on analysis recommendations. The AFMC metrics help deliver the proper process-linked and customer-focused analysis needed to manage supply activities and ensure AFMC is getting "…the right part, to the right place, at the right time, at the right price. (Koenig, 2003:5)

AFMC makes a distinction between two categories of metrics—performance measures and process indicators (Koenig, 2003:8). Performance measures are reported externally and is data that "indicate the strengths and opportunities for improvement in an organization" by highlighting measurements of organizational effectiveness, customer satisfaction, and cost effectiveness (Koenig, 2003:8). Process indicators are reported

internally to "provide information about or contribute to the understanding of a process" and "are used in root cause analysis of deviations in performance" (Koenig, 2003:8). Like AFLMA, AFMC links its six process indicators and three performance measures to the ultimate performance measure of aircraft availability, "the best measure of support to the warfighter and the key input to the requirements process" (Koenig, 2003:6). The ten measures AFMC advocates are as follows:

- Aircraft Availability (Performance) – percentage of time an aircraft is unavailable due to supply

- MICAP Hours (Performance) – measurement of the hours accrued in a given month for items affecting mission capability that are on backorder

- Customer Wait Time (Performance) – days measuring the average time between issuance of a warfighter order and receipt

- Net Operating Result (Performance) – the difference between revenue and expenses or a bottom line profit and loss indicator

- Total Requirements Variance (Process) – evaluation of expected backorders vs. actual due outs

- MICAP Incidents (Process) – measurement of the number of incidents based on the number of MICAP requisitions accumulated

- Backorders (Process) – number of demands placed on the supply system that can not be immediately satisfied from existing inventory (including stock replenishment)

- Issue Effectiveness (Process) – measure of supply account's ability to satisfy any customer demand

- Stockage Effectiveness (Process) – measure of supply account's ability to satisfy customer demand for authorized stockage items

- Logistics Response Time (Process) – days measuring the average time between issuance of a warfighter/base/depot retail order and receipt at base/depot supply (Koenig, 2003:9)

In addition to a description of each performance measure, AFMC provides a data source for obtaining the metric measures and annual performance targets for each supply chain management program in AFMC. This connection between metrics and performance targets is the final step in determining the effectiveness of a supply chain.

This research looked at an MRSP as a ‘supply chain in a box’ for a single customer over a specific period of time. Using these criteria, the metrics proposed by LMI and AFLMA encompass both higher levels of support and higher support objectives than appropriate for this research. However, the *AFMC Supply Chain Metrics Guide* provided two things. First, the metrics advocated by AFMC provided the most appropriate level of measuring MRSP effectiveness. Second, the guide included numerous sources of performance data and comparison metrics. Both were key elements to answering the proposed research and investigative questions.

Summary

This literature review presented information that explains the background of the analysis that was conducted in this research effort. First, it described the main components of MRSP configuration. Next it explored three recent research efforts that examined MRSP effectiveness during contingency operations. Finally, it examined literature that attempted to define the elements of an effective supply chain from DoD, corporate Air Force, and functional MAJCOM levels. The next chapter discusses the methodology used to conduct the research.

III. Methodology

Chapter Overview

The purpose of this chapter is to discuss the tools and techniques used to answer the investigative questions central to the research objective of this thesis. First is a summary of the problem. Second is a description of the measures selected to show MRSP effectiveness. Next is an examination of the data obtained and the analysis tools used. Finally this chapter ends with a summary of the topics covered.

Problem Summary

The purpose of this research is to determine whether the current method of configuring MRSPs provided effective support in the actual wartime scenario of Operation IRAQI FREEDOM (OIF). This is a good place to restate the investigative questions and sub-questions that will answer the research question.

1. How were MRSPs configured for OIF?
2. Did MRSPs effectively support the weapon systems during the first 30 days of operations?
    a. Did the MRSPs have *enough* spares for aircraft maintenance personnel to keep aircraft mission capable? In other words, did we take what was needed to the conflict?
    b. Did the MRSPs have the *right* spares for aircraft maintenance personnel to keep aircraft mission capable? In other words, did we need what we took to the conflict?

The next sections will provide a discussion of the selected effectiveness measures and the data required to answer these questions.

Selected Measures

As discussed in Chapter two, the Air Force uses a number of measures to determine whether a supply function provides effective support to a weapon system. When looking at an MRSP as a portable supply account, the measures selected to show MRSP effectiveness were mission capability spares (MICAP) incidents, fill rate, issue effectiveness, stockage effectiveness, and total requirements variance for both MRSP cost and spares used. Out of the available measures that can be used to determine supply chain effectiveness, these six metrics are critical in showing how MRSP composition in particular enables effective support to a weapon system. In other words, these metrics will show whether the MRSP met the supply chain goal of “getting the right part, to the right place, at the right time, at the right price” (Koenig, 2003:4). The next sections provide a description of each measure and a justification for how its selection helps answer the second investigative question.

Mission Capable Spares

Mission capability is whether a weapon system is able to perform its designated function. There are two types of mission capability that can be attributed to the MRSPs during a contingency. Not Mission Capable Supply (NMCS) means the weapon system is unable to perform any assigned missions due to a lack of parts in the MRSP. Partially Mission Capable Supply (PMCS) means the weapon system can perform at least one of its missions based on a basic system list but not all missions due to a lack of parts availability for systems on other mission essential subsystem lists.

In an NMCS or PMCS situation, the critical part preventing the aircraft from mission performance is referred to as a mission capable asset or spare (MICAP). MICAP

hours are accumulated from the time maintenance places an order in the supply system for the critical asset until the replacement asset is delivered to maintenance for repair action. Because there is an assumption of no MRSP resupply during the first 30 days of a contingency, a MICAP could cause serious problems with aircraft availability. First, the very lack of asset availability to repair the aircraft is a problem. Second, the amount of time utilized to bring the weapon system out of NMCS or PMCS status could be lengthy, especially in a contingency situation where resupply and repair facilities may not be comparable to those of a state-side facility.

Although contingency MICAPs are filled as priority due outs, the number of MICAPS for a weapon system speaks directly to effective MRSP composition in two ways. First, MICAPs for items authorized to be in the MRSP are a reflection of the right number of spares. Second, MICAPs for items not authorized to be in the MRSP are a refection of the right kind of spares.

Fill Rate

Fill rate is the percentage of authorized spares actually on hand in a MRSP. Fill rate is a function of several factors: how often spares are utilized, how often MRSP replenishment occurs, and how many authorized spares were actually in the MRSP at the time of deployment. The fill rate is determined by the ratio of available spares to authorized spares.

Because there is an assumption of no MRSP resupply during the first 30 days of a contingency, it is not surprising that the fill rate of a MRSP will decline over time. The level of declination however, is another reflection of MRSP effectiveness. A fill rate that declines slowly, coupled with a large number of MICAPs, means the MRSP may not

contain the right kind of spares. However, a fill rate that declines rapidly, coupled with a large number of MICAPs, means the MRSP may not contain the right number of spares.

Issue and Stockage Effectiveness

Both issue and stockage effectiveness (I/E and S/E) are weapon system support measures that reflect demand fulfillment. Just like fill rate, issue and stockage effectiveness are functions of MRSP utilization, replenishment actions, and spares on hand. Unlike fill rate, issue and stockage effectiveness are also affected by the number of spares a MRSP does not have in stock.

Issue effectiveness is the percentage of customer requests actually filled by items in the MRSP. Issue effectiveness is calculated by dividing the number of items issued by the number of items issued plus backorders, both authorized and not authorized to stock. Stockage effectiveness is the percentage of total spares authorized in the MRSP that are available upon customer request. Stockage effectiveness is calculated by dividing the number of items issued by the number of items issued plus authorized backorders only.

While stockage effectiveness is generally higher than issue effectiveness, issue effectiveness is more representative of actual customer support because it includes the total number of customer requirements. As MRSP effectiveness measures, each one indicates a different kind of MRSP performance. Issue effectiveness mainly reflects whether the MRSP contains the right kind of stock is available. Stockage effectiveness mainly reflects whether the MRSP contains the right amount of stock

Total Requirements Variance

In the traditional supply chain, total requirements variance (TRV) is the difference between expected back orders (EBO) and actual due outs (ADO). Because MRSPs are

calculated based on the probability of requiring certain reparables, it is not unreasonable to look at the authorized contents of a MRSP as EBOs. For this research, TRV was defined as the difference between what was authorized in the MRSP and what was used from the MRSP. This variance was shown using both the number of assets and the total cost of the assets.

Unlike the other MRSP effectiveness measures, TRV is not a measure of direct customer support. Instead, it is a performance measure that reflects whether the process used to stock the MRSP generated an accurate "shopping list" of what was needed. TRV shows not only how much of the MRSP was unused at the end of the 30-day period, but also the cost of over-allocated assets that are unavailable for use elsewhere in the supply chain.

Data, Sources, and Assumptions

This research is focused on MRSP effectiveness during OIF. As such, three different types of data sets were required to perform the necessary research: one to show MRSP configuration; one to show MRSP content; and one to show MRSP support. Data was collected from several Air Force databases to provide the data for analysis.

First, to show MRSP configuration, MRSP management at Air Combat Command (ACC/LGSWC) provided confirmation of MRSP configuration according to WMP-5 requirements for the 52 MRSPs and eight contingency high priority mission support kits (CHPMSK) under their management. Specifically, the three deployed MRSPs selected for analysis were configured according to WMP-5 requirements.

Second, to show MRSP content, a listing of authorized MRSP line items for each weapon system was required. This data was obtained in a text file from the D087G. The data was then imported into a Microsoft Excel spreadsheet to extract the required data elements. MRSP composition data from three different forward-deployed weapon system types was extracted. For the purposes of limiting the potential for obtaining results from a MRSP that was used to support more than its designated squadron at a single location, MRSP selection was limited to weapon systems that were the only one of its kind at a location. For example, MRSP parts for a C-130 would be highly unlikely to be cross utilized on an F-15. Table 2 shows the weapon system and deployed location obtained from the stock record account number (SRAN) listed with each kit on a listing of deployed RSPs provided by ACC/LGSWC.

Table 2. Weapon System Location

Weapon System	**Deployed Location**
E-3B	Thumrait Sultanate, Oman
F-16C	Al Jaber, Kuwait
HC-130P	Azraq, Jordan

Finally, to show MRSP support, data records showing MRSP issues and back orders during the contingency period provided the necessary information. This data came from two sources. First, Air Force demand data from 19 March to 17 April 2003 was obtained for the three specific weapon systems supported by the MRSPs from the Standard Base Supply System (SBSS) D002A transaction report function in a text file. The data was imported into several Microsoft Excel spreadsheets by national stock number blocks where it was segregated first by SRAN, then by organization code, which

indicated the maintenance organization that utilized the MRSP spares. Second, Air Force MICAP data for the same time period was obtained from the MICAP Requisition Status Reporting System (D165B) in a Microsoft Access file. The data was imported into Microsoft Excel spreadsheets by month where it was segregated first by SRAN, then by weapon system to extract the relevant MICAP data.

Assumptions and Limitations

Because of the multiple data sources used in this research and the nature of the spares computed by the D087G, several assumptions and limitations were necessary:

1. Data from the SBSS, D165B and D087G are complete and accurate for the specified weapon systems.

2. Data from the D165B was only available in a monthly format. The request date for an item was extracted from the document identification number as a Julian date to correspond with the daily format of the metrics.

3. Each MRSP began OIF with a 100% fill rate. This assumption is made for two reasons. First, it is reasonable to assume that before a MRSP deploys on a contingency operation, it will be robusted to full capacity through local supply channels and maintenance cannibalization actions. Second, data is not available concerning any maintenance actions taken en-route to a deployed location, which would cause a fill rate drop as part of the deployment but before the contingency began.

4. Most MRSPs contain items that are not listed on the D087G report because they cannot be computed or are incompatible with a flying hour program. This research was limited to analyzing those repairable spares that were computed, authorized, and assigned a stock level using the ASM in the D087G. This was done by first exporting each Excel spreadsheet into Microsoft Access. Next, the NSN of each issue, due out, or MICAP was matched against the NSNs for authorized spares on the D087G listing.

Metrics Methodology

Authorization, issue, and MICAP data was extracted from various databases. The next step was to use the extracted weapon system data to develop the proposed

effectiveness metrics. The following methods were employed to compute fill rate, issue effectiveness, stockage effectiveness, mission capability spares rates, and total requirements variance.

Fill Rate

Fill rate was computed on a daily basis. Only spares authorized by the D087G were used in the fill rate computation. The number of authorized spares unavailable for issue each day as reported in the SBSS transaction report was subtracted from the total number of authorized spares with a positive stockage level. This figure was then divided by the total number of authorized spares with a positive stockage level as recorded on the D087G report.

Issue and Stockage Effectiveness

Issue effectiveness was computed on a daily basis. The number of authorized spares with a positive stockage level that issued each day from the MRSP as reported in the SBSS transaction report was divided by the same number plus the total number of backorders (MICAPS) recorded on the same day on the D165B report.

Stockage effectiveness was also computed on a daily basis. The number of authorized spares with a positive stockage level that were issued each day as reported on the SBSS transaction report was divided by the same number plus only those MICAPS recorded on the D165B report with an authorized stockage level recorded on the D087G report.

Mission Capability Spares

MICAP data for each weapon system from the D165B was recorded on a daily basis. The daily record was compared with the MRSP authorization listing from the

D087G to determine whether or not the MICAP was authorized in the MRSP. The total number of MICAPS was computed for the end of the 30-day period.

Total Requirements Variance

Total requirements variance was computed using the item cost and requirement quantity data from the D087G report and the issue data from the SBSS transaction report. To compute asset TRV, the total number of authorized issued assets was subtracted from the total number of line items authorized in the MRSP. To compute cost TRV, authorized issued assets were multiplied by item cost, then subtracted from the product of authorized issued assets and item cost.

Metrics Application

After computing cumulative effectiveness measures for each weapon system during the first 30 days of OIF, the first four measurements were compared against overall weapon system supply chain performance during different available time periods. Performance measures were obtained from multiple data reporting sources to provide comparison data.

Fill rate was compared with average fill rates for OIF weapon system MRSPs during the time period 0300 Zulu 19 March to 0259 Zulu 18 April 2003. This information was provided by the Assessment and Analysis Division of Central Command Air Forces (CENTAF) in the 2003 report *Operation IRAQI FREEDOM—By The Numbers*.

Issue and stockage effectiveness measures were compared with two measures. First, they were compared with average issue and stockage effectiveness rates during the

months of March and April 2003 obtained from historical SBSS issue and stockage effectiveness data archived on the U.S. Air Force Installations and Logistics (HQ USAF/IL) Multi-Echelon Resource Logistics Information Network (MERLIN) system. Second, they were compared with 2003 AFMC issue and stockage effectiveness goals listed in the *FY2003 Supply Management Mission Area Operating Plan*.

There is no metric available against which to compare MICAP incidents. Instead, the comparison was made between MICAPS for authorized MRSP assets and MICAPS for unauthorized MRSP assets. The distinction was made by comparing the total number of weapon system MICAPs obtained from the D165B report with the D087G report of authorized MRSP assets.

There is no metric available against which to compare total requirements variance. Instead, the comparison was made between both the number and the cost of used and unused assets.

Summary

This chapter discusses the process used to conduct the analysis required to answer the research question. After a summary of the problem statement, a description of and justification for selected effectiveness measures was provided. Next, data sources and limitations were discussed. The methods used to compute the selected measures were then explained. Finally, this chapter discussed how the computed metrics would be analyzed. The next chapter presents the results of the analysis.

IV. Analysis and Results

Chapter Overview

This chapter presents the results of the data collection and analysis. This chapter is organized by aircraft type—E-3B, F-16C, and HC-130P. Each section begins with an overview of the MRSP deployed for the aircraft, including total number of items and cost. The next section contains the MRSP performance metrics selected in Chapter three—fill rate, issue effectiveness, stockage effectiveness, mission capable spares (MICAPs), and total requirements variance (TRV) for both items and cost. The chapter ends with a summary of the analysis and results.

E-3B MRSP Results

MRSP Composition: The data from the D087G provided a listing of each item considered for inclusion in the MRSP. Elements included stock number, quantity per application (QPA), cost per item, and authorized requirement quantity. Table 3 shows a summary of the configuration of the E-3B MRSP. The first row shows information on the items loaded into the D087G from the Mission Essential Subsystem List (MESL). The second row shows information on the items actually selected by the ASM for inclusion in the MRSP. The first column shows the total number of stock number items either considered or selected. The second column shows the total number of line items either considered or selected. The last column shows the total cost of the MRSP calculated by the sum of the products of cost per item and total number of line items either considered or selected. In this case, even though the number of stock number items decreased between units considered and units selected, the number of line items

and the total cost increased. This is a result of the ASM assigning a higher number of line items to particular stock numbers than was required by the MESL. Consequently, the cost of those additional line items is reflected in the higher total cost.

Table 3. Configuration of E-3B MRSP

	Stock Number Items	**Line Items**	**Total Cost**
Units Considered	287	805	$39,468,004.08
Units Selected	279	854	$ 40,537,174.24

MRSP Performance: Fill rate, issue effectiveness, and stockage effectiveness were calculated from the demand data captured from the D002A and the D165B using the methods described in the last chapter. Table 4 shows the results of those calculations.

Table 4. Performance Metrics for E-3B MRSP

	FILLED AUTHORIZED ITEM REQ	AVAILABLE KIT LINE ITEMS	FILL RATE	AUTHORIZED ITEM MICAPS	TOTAL MICAPS	I/E	S/E
19-Mar-03	0	845	1.000	0	0	1.000	1.000
20-Mar-03	1	844	0.999	0	2	0.333	1.000
21-Mar-03	0	844	0.999	0	0	0.333	1.000
22-Mar-03	0	844	0.999	0	0	0.333	1.000
23-Mar-03	0	844	0.999	0	0	0.333	1.000
24-Mar-03	2	842	0.996	0	0	0.600	1.000
25-Mar-03	4	838	0.992	0	0	0.778	1.000
26-Mar-03	0	838	0.992	0	0	0.778	1.000
27-Mar-03	2	836	0.989	0	0	0.818	1.000
28-Mar-03	0	836	0.989	0	0	0.818	1.000
29-Mar-03	0	836	0.989	0	0	0.818	1.000
30-Mar-03	4	832	0.985	0	0	0.867	1.000
31-Mar-03	0	832	0.985	0	0	0.867	1.000
1-Apr-03	0	832	0.985	0	0	0.867	1.000
2-Apr-03	1	831	0.983	0	0	0.875	1.000
3-Apr-03	0	831	0.983	0	0	0.875	1.000
4-Apr-03	0	831	0.983	0	0	0.875	1.000
5-Apr-03	0	831	0.983	0	0	0.875	1.000
6-Apr-03	3	828	0.980	0	1	0.850	1.000
7-Apr-03	5	823	0.974	0	0	0.880	1.000
8-Apr-03	5	818	0.968	0	0	0.900	1.000
9-Apr-03	1	817	0.967	1	1	0.875	0.966
10-Apr-03	0	817	0.967	0	0	0.875	0.966
11-Apr-03	0	817	0.967	0	0	0.875	0.966
12-Apr-03	0	817	0.967	0	0	0.875	0.966
13-Apr-03	5	812	0.961	0	0	0.892	0.971
14-Apr-03	0	812	0.961	0	0	0.892	0.971
15-Apr-03	1	811	0.960	0	0	0.895	0.971
16-Apr-03	0	811	0.960	0	0	0.895	0.971
17-Apr-03	0	811	0.960	0	0	0.895	0.971
TOTALS	34			1	4		

At the end of the 30-day period, 34 items were issued from the MRSP resulting in a 96% fill rate. There was only one MICAP for an item authorized in the MRSP and three MICAPS for items not authorized in the MRSP for a total of four MICAPS. The ratio between issues and authorized item MICAPS resulted in a stockage effectiveness of 97.1%. The ratio of issues and total MICAPS resulted in an issue effectiveness of 89.5%.

The comparisons of fill rate, issue effectiveness, and stockage effectiveness with overall weapon system metrics and goals are shown in Table 5. The first column shows each type of measurement. The next column shows the measurements for the E-3B MRSP. Each corresponding column pair shows the comparison metric and the difference (Delta) between the MRSP measurement and the comparison metric. Deltas in parenthesis represent a negative difference.

Table 5. MRSP Measures vs. Comparison Metrics

	MRSP	**OIF E-3 Total**	**Delta**	**AFMC 2003 Goal**	**Delta**	**2003 E-3 Total**	**Delta**
Fill Rate	96%	96.6%	(.6%)	---	---	---	---
I/E	89.5%	---	---	50%	39.5%	80.3%	9.2%
S/E	97.1%	---	---	62%	35.1%	90.7%	6.4%

Total requirements variance is shown in Table 6. The first row shows totals for the number of items in the MRSP and the cost of those items. The second row shows totals for the number of items issued from the MRSP during the 30-day period and the cost of those items. The last row shows the difference between the first and second rows.

Table 6. Total Requirements Variance of E-3B MRSP

	Number of Items	Total Cost
Line Items Available	845	$ 40,537,174.24
Line Items Used	34	$ 1,562,505.81
TRV	811	$ 38,974,668.43

Analysis: Of the 845 line items stocked in this MRSP, 34 were issued during the first 30 days of OIF. The ending fill rate of 96% is only .6% less than the cumulative fill rates for all E-3 aircraft participating in OIF. In other words, this MRSP filled five more requisitions than the average E-3 MRSP.

MICAPs for unauthorized parts were higher than authorized part MICAPS. With three of the four MICAPs being for parts not authorized in the MRSP, 75% of the MICAPs were for parts not listed on the MESL as critical grounding spares. However, the overall MICAP rate was low with respect to actual MRSP issues. With 34 issues for authorized parts and four total MICAPs for unavailable parts, 89.5% of reparable item needs were met by the MRSP.

Issue effectiveness rates for this MRSP compared favorably with the AFMC E-3 goals and the 2003 calendar year supply chain total rates. This MRSP beat the AFMC goal by 39.5% and the 2003 rate by 9.2%. This means that this E-3B MRSP provided more of the right spares to meet demand requirements than expected.

Stockage effectiveness rates for this MRSP also compared favorably with aggregate metrics and goals. This MRSP beat the AFMC goal by 35.1% and the 2003 rate by 6.4%. This means that this E-3B MRSP had more of the authorized spares to meet demand requirements than expected.

The total requirements variance showed that of the 845 items stocked in the MRSP, 811 items were still in the MRSP at the end of the 30-day period. This means only 4% of the MRSP was actually required. The total cost of the MRSP showed a variance of $38,974,668 between the cost of items stocked and the cost of items used. This means the MRSP contained over 25 times the value of the items actually issued to repair the weapon systems.

F-16C MRSP Results

MRSP Composition: The data from the D087G provided a listing of each item considered for inclusion in the MRSP. Elements included stock number, quantity per application (QPA), cost per item, and authorized requirement quantity. Table 7 shows a summary of the configuration of the F-16C MRSP. The first row shows information on the items loaded into the D087G from the Mission Essential Subsystem List (MESL). The second row shows information on the items actually selected by the ASM for inclusion in the MRSP. The first column shows the total number of stock number items either considered or selected. The second column shows the total number of line items either considered or selected. The last column shows the total cost of the MRSP calculated by the sum of the products of cost per item and total number of line items either considered or selected.

Table 7. Configuration of F-16C MRSP

	Stock Number Items	**Line Items**	**Total Cost**
Units Considered	271	356	$12,945,305.09
Units Selected	100	174	$ 13,766,422.93

In this case, both the number of stock number items and the number of line items decreased between units considered and units selected. However, the total cost increased. Again, this is a result of the ASM assigning additional line items to particular stock numbers, namely high cost items. Consequently, the cost of those additional line items is reflected in the higher total cost for units selected.

MRSP Performance: Fill rate, issue effectiveness, and stockage effectiveness were calculated from the demand data captured from the D002A and the D165B using the methods described in the last chapter. Table 8 shows the results of those calculations.

Table 8. Performance Metrics for F-16C MRSP

	FILLED AUTHORIZED ITEM REQ	AVAILABLE KIT LINE ITEMS	FILL RATE	AUTHORIZED ITEM MICAPS	TOTAL MICAPS	I/E	S/E
19-Mar-03	1	173	0.994	0	0	1.000	1.000
20-Mar-03	0	173	0.994	0	0	1.000	1.000
21-Mar-03	0	173	0.994	0	1	0.500	1.000
22-Mar-03	0	173	0.994	1	1	0.333	0.500
23-Mar-03	2	171	0.983	0	0	0.600	0.750
24-Mar-03	0	171	0.983	0	0	0.600	0.750
25-Mar-03	0	171	0.983	0	1	0.500	0.750
26-Mar-03	2	169	0.971	0	0	0.625	0.833
27-Mar-03	2	167	0.960	1	3	0.538	0.778
28-Mar-03	0	167	0.960	1	2	0.467	0.700
29-Mar-03	0	167	0.960	0	1	0.438	0.700
30-Mar-03	1	166	0.954	0	0	0.471	0.727
31-Mar-03	1	165	0.948	0	3	0.429	0.750
1-Apr-03	0	165	0.948	1	1	0.409	0.692
2-Apr-03	1	164	0.943	1	1	0.417	0.667
3-Apr-03	0	164	0.943	0	0	0.417	0.667
4-Apr-03	0	164	0.943	0	0	0.417	0.667
5-Apr-03	0	164	0.943	0	0	0.417	0.667
6-Apr-03	0	164	0.943	0	0	0.417	0.667
7-Apr-03	1	163	0.937	0	1	0.423	0.688
8-Apr-03	1	162	0.931	0	1	0.429	0.706
9-Apr-03	0	162	0.931	3	3	0.387	0.600
10-Apr-03	1	161	0.925	0	1	0.394	0.619
11-Apr-03	0	161	0.925	0	0	0.394	0.619
12-Apr-03	0	161	0.925	0	0	0.394	0.619
13-Apr-03	0	161	0.925	0	0	0.394	0.619
14-Apr-03	0	161	0.925	1	1	0.382	0.591
15-Apr-03	0	161	0.925	1	1	0.371	0.565
16-Apr-03	0	161	0.925	1	1	0.361	0.542
17-Apr-03	0	161	0.925	0	0	0.361	0.542
TOTALS	**13**			**11**	**23**		

At the end of the 30-day period, 13 items were issued from the MRSP resulting in a 92.5% fill rate. There were 11 MICAPs for an item authorized in the MRSP and 12 MICAPs for items not authorized in the MRSP for a total of 23 MICAPS. The ratio

between issues and authorized item MICAPS resulted in a stockage effectiveness of 54.2%. The ratio of issues and total MICAPS resulted in an issue effectiveness of 36.1%.

The comparisons of fill rate, issue effectiveness, and stockage effectiveness with overall weapon system metrics and goals are shown in Table 9. The first column shows each type of measurement. The next column shows the measurements for the F-16C MRSP. Each corresponding column pair shows the comparison metric and the difference (Delta) between the MRSP measurement and the comparison metric. Deltas in parenthesis represent a negative difference.

Table 9. MRSP Measures vs. Comparison Metrics

	MRSP	OIF F-16 Total	Delta	AFMC 2003 Goal	Delta	2003 F-16 Total	Delta
Fill Rate	92.5%	92.4%	.1%	---	---	---	---
I/E	36.1%	---	---	67%	(30.9%)	71.7%	(35.6%)
S/E	54.2%	---	---	77%	(22.8%)	82.7%	(28.5%)

Total requirements variance is shown in Table 10. The first row shows totals for the number of items in the MRSP and the cost of those items. The second row shows totals for the number of items issued from the MRSP during the 30-day period and the cost of those items. The last row shows the difference between the first and second rows.

Table 10. Total Requirements Variance of F-16C MRSP

	Number of Items	Total Cost
Line Items Available	174	$ 13,766,422.93
Line Items Used	13	$ 1,860,280.13
TRV	161	$ 11,906,142.80

Analysis: Of the 174 line items stocked in this MRSP, 13 were issued during the first 30 days of OIF. The ending fill rate of 92.5% is only .1% more than the cumulative fill rates for all F-16 aircraft participating in OIF.

MICAPs for unauthorized parts were higher than authorized part MICAPS, but only by one reparable. With 12 of the 23 MICAPs being for parts not authorized in the MRSP, 52% of the MICAPs were for parts not listed on the MESL as critical grounding spares. The overall MICAP rate was very high with respect to actual MRSP issues. With 13 issues for authorized parts and 23 total MICAPs for unavailable parts, only 36.1% of reparable item needs were met by the MRSP.

Issue effectiveness rates for this MRSP did not compare favorably with either the AFMC F-16 goals or the 2003 calendar year supply chain total rates. This MRSP fell below the AFMC goal by 30.9% and the 2003 rate by 35.6%. This means that this F-16C MRSP provided less of the right spares to meet demand requirements than expected.

Stockage effectiveness rates for this MRSP also compared unfavorably with aggregate metrics and goals. This MRSP fell below the AFMC goal by 22.8% and the 2003 rate by 28.5%. This means that this F-16C MRSP had less of the authorized spares needed to meet demand requirements than expected.

The total requirements variance showed that of the 174 items stocked in the MRSP, 161 items were still in the MRSP at the end of the 30-day period. This means only 7.5% of the MRSP was actually required. The total cost of the MRSP showed a variance of $11,906,142 between the cost of items stocked and the cost of items used. This means the MRSP contained over seven times the value of the items actually issued to repair the weapon systems.

HC-130P MRSP Results

MRSP Composition: The data from the D087G provided a listing of each item considered for inclusion in the MRSP. Elements included stock number, quantity per application (QPA), cost per item, and authorized requirement quantity. Table 11 shows a summary of the configuration of the HC-130P MRSP. The first row shows information on the items loaded into the D087G from the Mission Essential Subsystem List (MESL). The second row shows information on the items actually selected by the ASM for inclusion in the MRSP. The first column shows the total number of stock number items either considered or selected. The second column shows the total number of line items either considered or selected. The last column shows the total cost of the MRSP calculated by the sum of the products of cost per item and total number of line items either considered or selected. In this case, selected stock number items, line items, and total cost all decreased from the corresponding considered values.

Table 11. Configuration of HC-130P MRSP

	Stock Number Items	**Line Items**	**Total Cost**
Units Considered	179	484	$ 7,058,276.32
Units Selected	132	271	$ 4,823,335.22

MRSP Performance: Fill rate, issue effectiveness, and stockage effectiveness were calculated from the demand data captured from the D002A and the D165B using the methods described in the last chapter. Table 12 shows the results of those calculations.

At the end of the 30-day period, 20 items were issued from the MRSP resulting in a 92.6% fill rate. There were four MICAPs for authorized items in the MRSP and zero MICAPS for items not authorized in the MRSP for a total of four MICAPS. The ratio

between issues and authorized item MICAPS resulted in a stockage effectiveness of 83.3%. The ratio of issues and total MICAPS resulted in an issue effectiveness of 83.3%.

Table 12. Performance Metrics for HC-130P MRSP

	FILLED AUTHORIZED ITEM REQ	AVAILABLE KIT LINE ITEMS	FILL RATE	AUTHORIZED ITEM MICAPS	TOTAL MICAPS	I/E	S/E
19-Mar-03	0	271	1.000	0	0	1.000	1.000
20-Mar-03	2	269	0.993	0	0	1.000	1.000
21-Mar-03	0	269	0.993	0	0	1.000	1.000
22-Mar-03	0	269	0.993	0	0	1.000	1.000
23-Mar-03	1	268	0.989	0	0	1.000	1.000
24-Mar-03	0	268	0.989	0	0	1.000	1.000
25-Mar-03	0	268	0.989	0	0	1.000	1.000
26-Mar-03	0	268	0.989	0	0	1.000	1.000
27-Mar-03	0	268	0.989	0	0	1.000	1.000
28-Mar-03	0	268	0.989	0	0	1.000	1.000
29-Mar-03	0	268	0.989	0	0	1.000	1.000
30-Mar-03	0	268	0.989	0	0	1.000	1.000
31-Mar-03	2	266	0.982	0	0	1.000	1.000
1-Apr-03	0	266	0.982	1	1	0.833	0.833
2-Apr-03	0	266	0.982	0	0	0.833	0.833
3-Apr-03	0	266	0.982	0	0	0.833	0.833
4-Apr-03	0	266	0.982	0	0	0.833	0.833
5-Apr-03	0	266	0.982	0	0	0.833	0.833
6-Apr-03	2	264	0.974	0	0	0.875	0.875
7-Apr-03	0	264	0.974	0	0	0.875	0.875
8-Apr-03	0	264	0.974	0	0	0.875	0.875
9-Apr-03	1	263	0.970	0	0	0.889	0.889
10-Apr-03	0	263	0.970	0	0	0.889	0.889
11-Apr-03	0	263	0.970	1	1	0.800	0.800
12-Apr-03	0	263	0.970	0	0	0.800	0.800
13-Apr-03	7	256	0.945	0	0	0.882	0.882
14-Apr-03	0	256	0.945	0	0	0.882	0.882
15-Apr-03	0	256	0.945	0	0	0.882	0.882
16-Apr-03	5	251	0.926	0	0	0.909	0.909
17-Apr-03	0	251	0.926	2	2	0.833	0.833
TOTALS	**20**			**4**	**4**		

The comparisons of fill rate, issue effectiveness, and stockage effectiveness with overall weapon system metrics and goals are shown in Table 13. The first column shows each type of measurement. The next column shows the measurements for the HC-130P MRSP. Each corresponding column pair shows the comparison metric and the difference (Delta) between the MRSP measurement and the comparison metric. Deltas in parenthesis represent a negative difference.

Table 13. MRSP Measures vs. Comparison Metrics

	MRSP	OIF HC-130 Total	Delta	AFMC 2003 Goal	Delta	2003 HC-130 Total	Delta
Fill Rate	92.6%	92.5%	.1%	---	---	---	---
I/E	83.3%	---	---	64%	19.3%	70%	13.3%
S/E	83.3%	---	---	80%	3.3%	89.4%	(6.1%)

Total requirements variance is shown in Table 14. The first row shows totals for the number of items in the MRSP and the cost of those items. The second row shows totals for the number of items issued from the MRSP during the 30-day period and the cost of those items. The last row shows the difference between the first and second rows.

Table 14. Total Requirements Variance of HC-130P MRSP

	Number of Items	Total Cost
Line Items Available	271	$ 4,823,335.22
Line Items Used	20	$ 181,718.37
TRV	251	$ 4,641,616.85

Analysis: Of the 271 line items stocked in this MRSP, 20 were issued during the first 30 days of OIF. The ending fill rate of 92.6% is only .1% more than the cumulative fill rates for all HC-130 aircraft participating in OIF.

There were no MICAPs for unauthorized parts. All four MICAPs for aircraft supported by this MRSP were for parts listed on the MESL as critical grounding spares. The MRSP did not contain the spares to meet those repeat requirements. However, the overall MICAP rate was low with respect to actual MRSP issues. With 20 issues for authorized parts and four total MICAPs for unavailable parts, 83.3% of reparable item needs were met by the MRSP.

Issue effectiveness rates for this MRSP compared very favorably with the AFMC HC-130 goals and the 2003 calendar year supply chain total rates. This MRSP beat the AFMC goal by 19.3% and the 2003 rate by 13.3%. This means that this HC-130P MRSP provided more of the right spares to meet demand requirements than expected.

Stockage effectiveness rates for this MRSP also compared favorably with aggregate metrics and goals. This MRSP beat the AFMC goal by 3.3%. However, it did fall behind the 2003 rate by 6.1%. Overall, this HC-130P MRSP had more of the authorized spares to meet demand requirements than expected, but less than the historical totals.

The total requirements variance showed that of the 271 items stocked in the MRSP, 251 items were still in the MRSP at the end of the 30-day period. This means only 7.4% of the MRSP was actually required. The total cost of the MRSP showed a variance of $4,641,616 between the cost of items stocked and the cost of items used. This means the MRSP contained over 27 times the value of the items actually issued to repair the weapon systems.

Summary

This chapter presented the results of the data collection, which showed that two of the three MRSPs performed favorably with regards to issue and stockage effectiveness when compared to MAJCOM 2003 goals and rates. All three MRSPs maintained a fill rate almost equal to that of the total weapon system MRSP fill rate during the entire conflict period. Data analysis also showed a large variance in two factors—the number of items in the MRSP versus the number of items actually used, and the cost of the items

in the MRSP versus the cost of the items used. The next chapter will consider the implications of these results as well as discuss other possible areas for research.

V. Conclusions and Recommendations

Chapter Overview

This thesis research effort was conducted with the goal of gaining an understanding of how MRSPs are performing in real-world contingency operations. Although the Air Force has been officially operating under a new force and deployment structure since 1999, MRSP configuration policies remain essentially unchanged. In order to reach the aforementioned goal, the research was structured to answer two main investigative questions and two sub-questions.

1. How were MRSPs configured for OIF?
2. Did MRSPs effectively support the weapon systems during the first 30 days of operations?
    a. Did the MRSPs have *enough* spares for aircraft maintenance personnel to keep aircraft mission capable? In other words, did we take what was needed to the conflict?
    b. Did the MRSPs have the *right* spares for aircraft maintenance personnel to keep aircraft mission capable? In other words, did we need what we took to the conflict?

This chapter will first discuss the answers to these questions and the conclusions that can be drawn from those answers. Then it will present recommendations for action. Finally the remainder of the chapter will identify areas of future research that would continue to add insight into this subject matter.

Conclusions

This section answers the investigative questions and sub-questions originally posed in Chapter one and restated in the introduction of this chapter. The answer to

Investigative Question one was obtained through information provided by the responsible office. The answers to Investigative Question two and Sub-questions one and two were obtained from the analysis performed in Chapter four.

How were MRSPs configured for OIF?

Research showed that MRSP configuration for OIF was accomplished using the WMP-5 flying hour scenario. The D087G was the tool used to stock the MRSPs with the reparables calculated by the ASM. Although the Air Force deployed its personnel under the AEF schedule, the MRSPs were still configured to support a different operational scenario.

Did MRSPs effectively support the weapon systems during the first 30 days of operations?

Although Air Force leadership has mandated that the ultimate measure of supply chain success is aircraft availability, there are other factors that determine effectiveness. The measures selected to determine the effectiveness of the three MRSPs studied in this research—fill rate, MICAP rates, issue effectiveness, stockage effectiveness, and total requirements variance— show that the MRSPs were effective in some respects and ineffective in others. Specifically, the MRSPs for the E-3B and HC-130P were considerably more effective than the F-16C MRSP.

Did the MRSPs have *enough* spares for the maintainers to keep aircraft mission capable?

The two effectiveness measures that best show whether the MRSPs contained enough of what was needed to support operations are fill rate and stockage effectiveness. Table 15 summarizes these two measurements for each weapon system MRSP.

Table 15. Fill Rate and Stockage Effectiveness Summary

	Fill Rate	**Stockage Effectiveness**
E-3B	96.0%	97.1%
F-16C	92.5%	54.2%
HC-130P	92.6%	83.3%

All three MRSPs maintained high fill rates equivalent to overall weapon system MRSP fill rates during the contingency. Requirements for this MRSP did not appear to be driven by the need to fill holes that existed prior to the deployment. Unmet demands were either for assets not authorized to be in the MRSPs or for assets that had multiple requirements above the number of authorized MRSP assets.

When compared to MAJCOM standards and annual rates, two of the three MRSPs contained an above average amount of reparables for maintenance personnel to repair the aircraft, as reflected by the stockage effectiveness rate. Stockage effectiveness was driven by the number of authorized part MICAPs for the weapon system. A MRSP that did not contain enough spares to cover multiple requirements for the same spare would experience low stockage effectiveness.

Both the E-3B and the HC-130P MRSPs had low authorized part MICAP occurrences when compared to total requests against the MRSP. For the E-3B MRSP, authorized spare MICAPs represented less than 3% of total MRSP requests. For the HC-130P MRSP, authorized spare MICAPs represented less than17% of total MRSP requests. Asset requirements above MRSP authorizations resulted in a below average performance from the F16C MRSP. For the F-16C MRSP, authorized part MICAPs accounted for almost 31% of the total requests against the MRSP. At the end of the first 30 days of OIF, the MRSPs for the E-3B and HC-130P had enough spares to satisfy the

majority of authorized reparable requests. The F-16C MRSP did not have enough spares to satisfy almost half of the authorized reparable requests.

Did the MRSPs have the *right* spares for the maintainers to keep aircraft mission capable?

The two effectiveness measures that best show whether maintenance personnel needed what was in the MRSPs to support weapon system repairs are issue effectiveness and total requirements variance (TRV). Table 16 summarizes these two measurements for each weapon system MRSP.

Table 16. Issue Effectiveness and TRV Summary

	Issue Effectiveness	Line Item TRV	Cost TRV
E-3B	89.5%	811	$ 38,974,668.43
F-16C	36.1%	161	$ 11,906,142.80
HC-130P	83.3%	251	$ 4,641,616.85

When compared to MAJCOM standards and annual rates, two of the three MRSPs contained an above average depth of necessary reparables for maintenance personnel to repair the aircraft, as reflected by the issue effectiveness rate. Issue effectiveness was driven by the number of total weapon system MICAPs, for both authorized and unauthorized MRSP assets. A MRSP that did not contain the right type of spares to cover repair requirements would experience low issue effectiveness.

Both the E-3B and the HC-130P MRSPs had low total MICAP occurrences when compared to total requests against the MRSP. For the E-3B MRSP, total MICAPs represented less than 11% of total MRSP requests. For the HC-130P MRSP, total MICAPs represented less than 17% of total MRSP requests. Asset requirements above

MRSP spares availability resulted in a below average performance from the F16C MRSP. For the F-16C MRSP, total MICAPs accounted for almost 64% of the total requests against the MRSP. At the end of the first 30 days of OIF, the MRSPs for the E-3B and HC-130P had the right spares to satisfy the majority of reparable requests. The F-16C MRSP did not have the right spares to satisfy almost 65% of the authorized reparable requests.

All three MRSPs showed a large TRV in both line item quantity and cost. Although an MRSP is designed to meet the particular needs of a specific weapon system, the underutilization of assets specifically selected to minimize aircraft grounding has several implications. First, the spares in these MRSPs were removed from the supply pipeline and made unavailable to satisfy other requirements, MICAP or otherwise. Next, for these three MRSPs alone, over $56 million in spares were purchased for requirements that did not occur. Third, the logistics footprint left by these three MRSPs, to include transportation, warehousing, and accountability requirements, was probably substantial. Finally, regulations mandate that “items and quantities in RSPs will, in all cases, be the minimum necessary to support major command required missions as reflected in the WMP tasking” (DAF, 2004:Ch.14, 6). These three MRSPs do not appear to meet this requirement.

Recommendations

This research effort showed that MRSP effectiveness during Operation IRAQI FREEDOM could have been better, specifically for the three MRSPs examined. The

following recommendations for action may help improve overall MRSP effectiveness for future contingencies.

The first recommendation is that the USAF should establish and maintain an official contingency demand database for MRSPs. AFLMA reported in March 2000 that "there are *no* programs or procedures in AFMAN 23-110 to describe collecting and transferring reparable demand data from the contingency site to the home base" (Smith, 2000:1). A contingency demand database would accomplish several goals. First, it would reduce the amount of data extraction and compilation required from multiple data sources to obtain an accurate picture of contingency requirements, something experienced by this researcher first hand. Next, it would provide the ASM with actual wartime reparable failure rates as opposed to the peacetime failure rates used to set MRSP levels. If there is a difference between wartime and peacetime demand patterns, the ASM may not be providing as accurate a product using peacetime failure rates. Finally, for MRSP review purposes, contingency data will provide a true picture of MRSP performance during wartime as opposed to one provided by aggregated wartime and peacetime data.

The second recommendation is that the USAF consider whether MRSPs should still be required to maintain assets to satisfy 30 days without resupply in today's contingency environment. The real ability for reach back and resupply, as accomplished to satisfy MICAPs, might make the 30-day requirement an unnecessary condition of MRSP spares configuration. Contingency operations are unpredictable and MRSPs satisfy a real requirement for on-hand reparable assets in an uncertain environment.

However, the speed and effectiveness of the logistics pipeline to satisfy reparable requirements should be considered as a possible MRSP inventory reduction tool.

The third recommendation is that the USAF review the contingency MICAPs that were not predicted on the MESL as grounding spares. The F-16C MRSP in particular experienced a high number of demands for reparable items that were not authorized to be in the MRSP. Contingency MICAP data would help show whether there are new reparables that should be considered for inclusion on the MESL.

The final recommendation is that the USAF consider whether the War and Mobilization Plan, Volume 5 (WMP-5) still provides the best guidelines for establishing MRSP inventory. If the ASM is dependent upon the contingency data provided in the WMP-5 to formulate the “best mix of spares” for the MRSP, it stands to reason that the more accurate the plan, the better the output. Leadership should question whether the WMP-5 is still the best plan on which to base MRSP composition when its scenario does not match today’s warfighting environment.

Future Research

This research identified effectiveness issues with three specific MRSPs during Operation IRAQI FREEDOM. Four areas of additional research could continue to enhance Air Force knowledge of how MRSP composition affects effectiveness during contingency operations.

First, a continuation of MRSP contingency performance documentation is necessary. The provision of accurate contingency data will help logistics leaders make improvements in MRSP configuration. The performance of either other MRSPs during

OIF or MRSPs during other contingency operations could be measured and compared with the results of this research.

Second, a study of the factors used in the ASM could be accomplished. An analysis of the seven additional ASM considerations outlined in Chapter two could reveal which ones, in addition to cost and the direct support objective, contribute most to the reparables selected for inclusion in the MRSP.

Third, a conclusive link between MRSP effectiveness and aircraft availability could be established. If the main purpose of the supply chain is to enable desirable levels of aircraft availability, leadership should know how different parts of the supply chain, including MRSPs, contribute to the rates. This would require analyzing mission capable data, including MICAP and total non-mission capable supply (TNMCS) hours and rates, and actual flying hours at the individual tail number level to determine the effect on the availability of the aircraft inventory.

Finally, use of the WMP-5 as the document that dictates MRSP support parameters could be addressed. A study that compares current MRSP configuration policy with a MRSP configured using parameters that reflect a current or recent AEF deployment and contingency response scenarios could possibly provide an improved method for determining MRSP reparable requirements.

Summary

In this research, the primary research question proposed in Chapter one, "What was the effect of MRSP configuration on current Air Force contingency operations support?" was answered by developing and answering two investigative questions.

Chapter two reviewed literature directed at guiding the research towards the information required to answer the investigative questions central to the research question. Chapter three defined and described the methodology developed to answer the investigative questions. Chapter four provided an analysis of the results obtained from applying the suggested methodology. Finally, conclusions were made about the effectiveness of MRSPs during OIF, as well as recommendations for action and suggestions for future research on MRSP configuration effectiveness.

Appendix 1. Sample of SBSS Transaction Report

```
       1005000179540   3300 118 AR ZZZ ZZZ  ZZZ       XB3  S9C  ISU  3P       3
R118AR30850009            C   000SHOPZZZZZZZ 26-MAR-03 DETENT PAWL     S9C
       1005000179540   3300 118 AR ZZZ ZZZ  ZZZ       XB3  S9C  DUO  4W       2
R118AR30850009            C   000SHOPZZZZZZZ 26-MAR-03 DETENT PAWL     S9C
       1005000179543   2067 677 SE ??? 187  7         XB3  S9C  DUO  4W       5
R677SE30830087         T  A   CRAIG63187     25-MAR-03 HANDLE ASSEMB   S9C
       1005000179546   2027 655 AE ??? 727  754       XB3  B14  DUO  4W      15
R655AE30930011         M  A   HUNTSMN72754ZZ 03-APR-03 HANDLE ASSEMB   B14
       1005000179546   2067 677 SE ??? 318  87        XB3  B14  DUO  4W       5
R677SE30830035         T  A   CRAIG 63187    25-MAR-03 HANDLE ASSY     B14
       1005000179546   4427 687 AT ZZZ ZZZ  ZZZ       XB3  B14  DUO  4W       5
X687AT30800710         M  B   SHOPUSEZZZZZ   23-MAR-03 CHARGING HAND   B14
       1005000179546   5810 224 CO RSB RSB  BZZ       XB3  B14  DUO  4W       2
X224CO30850001 Q    9GF O  A   SHOPUSERSBZZ1C 26-MAR-03 HANDLE ASSY,C   B14
       1005000179547   2067 677 SE ??? -31  187       XB3  S9C  DUO  4W       5
R677SE30830016         T  A   CRAIG 6-3187   24-MAR-03 PIN             S9C
       1005000179547   4608 416 SQ ZZZ ZZZ  ZZZ       XB3  S9C  DUO  4W      20
X416SQ30901000 G          B   CATMZZZZZZZZ1C 31-MAR-03 PIN,FIRING      S9C
       1005000179547   4690 480 SA ZZZ ZZZ  ZZZ       XB3  S9C  DUO  4W       5
X480SA30930745         M  A   CATMZZZZZZZZZZ 03-APR-03 PIN, FIRING     S9C
       1005000179547   5810 224 CO RSB RSB  BZZ       XB3  S9C  DUO  4W       6
X224CO31050003 Q    9GJ O  A   M16A200RSBZZ1C 15-APR-03 PIN,FIRING      S9C
       1005000179547   5819 380 OP BL5 BL5  5CA       XB3  S9C  DUO  4W       5
X380OP30650010      9BU O  A   BLODGETBL5CA1C 23-MAR-03 PIN, FIRING     S9C
       1005000179548   2067 677 SE ??? -31  187       XB3  S9C  DUO  4W       5
```

Appendix 2. Sample of D0165G Report

```
60F016XXXXXXXX            1005000566753  GUN,AUTOMATIC,20 MI275AAB  1248728  1  257   43
214  6  6 830RRRLRUY     T8000AEA    1    0    1 100 17  0  11               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1005010086283  HOUSING,MACHINE GUN275A99   590892  1    0    0
0  2  2 7 6RR LRUY     T800XAEA    1    0    1 100  0  0  11               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1005010446174  DRUM ASSEMBLY,AMMUN275ABC  3098580  1  184  110
74  6  6 830RR LRUY     T8000AEA    1    0    1 100 60  0  11               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1005010463536  TRANSFER UNIT,AMMUN275ACA  1143834  1  147  110
37 10  6 730RR LRUY     T8000AEA    1    0    1 100 75  0  10               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1005010556484  ACCESS UNIT,LOADING275ACE   602902  1  511  408
102  9  6 730RR LRUY     T8000AEA    1    0    1 100 80  0  10               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1260014396698WFGENERATOR,DISPLAY,P174KG0 10255400  1 1823  768
1056  4  415 9RR LRUC     T0000AEA    1    0    1 100 42  0  10               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1270012330011WFRECEIVER-GENERATOR,274AN0 32523200  1 3162 2299
862  5  512 8RR LRUC     T1000AEA    1    0    1 100 73  0  10               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1270012383662WFTRANSMITTER SUBASSE274AP0 60354300  1 1470  895
575  5  51430RR LRUC     T1000AEA    0    0    0 100 61  0  10               000
000               000               000 10010000    0    0    0        0F016C.000000000
60F016XXXXXXXX            1270013963088WFPROCESSOR,RADAR TAR274AY0 42367600  1 1896  271
```

Appendix 3. Sample of D165B Report

FSC	NIIN	MMAC	MICAP Hrs	MTD MICAP Hrs	Units	. MICAP Incident	MDS	Eq Designator	SRAN	SRAN	Cause Code	Doc .
5995	000012546	EW	482	421	1	1	ALQ184V	ALQ184V7	FB5284	FBXXXX	A	FBXXXX30570187
5995	000012546	EW	171	171	1	1	ALQ184V	ALQ184V7	FB5284	FBXXXX	J	FBXXXX30700018
9540	000015135		48	48	12	1	T038C	T038C	FB4830	FBXXXX	A	FBXXXX30709001
5985	000015788	EH	25	25	1	1	GPN020	GPN020	FB4484	FBXXXX	A	FBXXXX30839253
5935	000015920	EH	39	39	1	1	F015E	F015E	FB4852	FBXXXX	A	FBXXXX30639816
5935	000018645	EH	35	35	1	1	A010A	A010A	FB4852	FBXXXX	A	FBXXXX30779803
5306	000019756		447	447	10	1	MJ1	MJ1	FB6221	FBXXXX	A	FBXXXX30720170
6625	000030971	ID	93	59	1	1	MEP006A	MEP006A	FB5587	FBXXXX	A	FBXXXX30580106
6625	000030971	ID	705	254	1	1	MEP005A	MEP005A	FB5810	FBXXXX	A	FBXXXX30419811
6625	000030972	TG	469	254	1	1	MEP005A	MEP005A	FB5810	FBXXXX	A	FBXXXX30519806
6625	000030972	TG	98	98	1	1	MEP113A	MEP113A	FB6141	FBXXXX	A	FBXXXX30659300
6625	000030972	TG	705	254	1	1	MEP005A	MEP005A	FB5810	FBXXXX	B	FBXXXX30419813
1560	000031965	UC	4	4	1	1	C005A	C005A	FB4419	FBXXXX	B	FBXXXX30629158
1560	000031965	UC	30	30	1	1	C005A	C005A	FB4419	FBXXXX	B	FBXXXX30629158
4730	000038824	SX	92	92	1	1	F016C	F016C	FB5004	FBXXXX	A	FBXXXX30729553
6145	000039527	EH	77	77	99	1	M32A86D	M32A86D	FB6606	FBXXXX	A	FBXXXX30690562
5331	000043096	SX	38	38	22	1	HH060G	HH060G	FB4852	FBXXXX	H	FBXXXX30709809
5305	000043162	SX	142	84	4	1	M32A86D	M32A86D	FB6482	FBXXXX	A	FBXXXX30570153
3110	000043166		26	26	1	1	T038A	T038A	FB3029	FBXXXX	J	FBXXXX30620131
3110	000043166		22	22	1	1	T038A	T038A	FB3029	FBXXXX	J	FBXXXX30620175
3110	000043166		96	61	1	1	T038A	T038A	FB3029	FBXXXX	K	FBXXXX30580123
2840	000043966	SX	119	119	1	1	T56A15	T0056015	FB2500	FBXXXX	A	FBXXXX30720094
5315	000045048	SX	90	90	2	1	MS7T20	MS7T20	FB6131	FBXXXX	A	FBXXXX30660533
1560	000045581	SX	311	311	1	1	GRDHAND	GRDHAND	FB3010	FBXXXX	A	FBXXXX23170126
5905	000046112	EH	95	95	1	1	E24T169	E24T169	FB5000	FBXXXX	A	FBXXXX30800103
5331	000046392	PP	78	78	6	1	T56A7B	T0056007B	FB5612	FBXXXX	R	FBXXXX30849802
9535	000047321		320	320	1	1	F016C	F016C	FB5004	FBXXXX	A	FBXXXX30779557
9535	000047321		301	301	1	1	F016C	F016C	FB5004	FBXXXX	A	FBXXXX30789528
5330	000050413	SX	25	25	18	1	T038C	T038C	FB4830	FBXXXX	A	FBXXXX30639000
5960	000052080	EH	117	117	1	1	TPN024	TPN024	FB5808	FBXXXX	A	FBXXXX30809800
5935	000052826	SX	78	78	1	1	F016C	F016C	FB4855	FBXXXX	B	FBXXXX30809803
5935	000052828	SX	44	44	1	1	C005A	C005A	FB6606	FBXXXX	A	FBXXXX30890047
6625	000053858	TG	150	150	1	1	GPN022	GPN022	FB4852	FBXXXX	A	FBXXXX30700032
6850	000055305		272	272	1	1	F016C	F016C	FB4852	FBXXXX	A	FBXXXX30669820
6850	000055305		676	77	24	1	F016C	F016C	FB4852	FBXXXX	H	FBXXXX30350659
6850	000055305		34	34	22	1	F016C	F016C	FB4852	FBXXXX	H	FBXXXX30639804
6850	000055305		52	52	2	1	F016C	F016C	FB4852	FBXXXX	H	FBXXXX30779520
5320	000056252	SX	84	84	2	1	F015C	F015C	FB5270	FBXXXX	A	FBXXXX30800420
4720	000057548	SX	1246	744	2	1	ACE8023	ACE802329S	FB5685	FBXXXX	A	FBXXXX30399301
5330	000058557	SX	113	113	2	1	C005A	C005A	FB6606	FBXXXX	H	FBXXXX30869803

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Vita

Capt Smith attended Booker T. Washington High School and graduated in 1987. She graduated with honors from the University of Oklahoma in December 1996 after earning a Bachelor of Arts in Letters. Capt Smith received her commission on 30 September 1999 and was immediately assigned to the 1st Supply Squadron, Langley AFB, Virginia.

While stationed at Langley, Capt Smith served as Storage and Distribution Element Commander, Flightline Support Element Commander and Combat Operations Support Flight Commander. Following the merger of the 1st Supply Squadron into the 1st Logistics Readiness Squadron, Capt Smith served as Vehicle Operations Element Commander and Vehicle Management Flight Commander. While stationed at Langley, she deployed to Prince Sultan Air Base, Kingdom of Saudi Arabia for 90 days and served as Material Storage and Distribution Flight Commander in the 366th Expeditionary Supply Squadron.

In August 2002 she began the Logistics Management Program at the Air Force Institute of Technology, Wright Patterson AFB, Ohio. Upon graduation, she will be assigned to the Air Force Logistics Management Agency, Maxwell AFB, Gunter Annex, Alabama.

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14. ABSTRACT

Utilizing the Aircraft Sustainability Model (ASM), Air Force logisticians must determine the best possible number and mix of spares and repair parts for each deployable readiness spares package, better known as a mobility readiness spares package (MRSP). By analyzing MRSP support for Operation IRAQI FREEDOM (OIF), Air Force leadership can have a current picture of MRSP operational effectiveness and mission support capabilities. This research focused on determining the current configuration of MRSPs for OIF by selecting a representative array of MRSPs and supported weapon systems actively involved in OIF, and obtaining relevant support effectiveness measures. Measures selected for analysis were MRSP fill rate, stockage effectiveness, issue effectiveness, mission capable spares rate, and total requirements variance. An analysis of MRSPs for the E-3B, F-16C, and HC-130P aircraft revealed varying levels of effectiveness when compared with overall contingency and supply chain metrics.

15. SUBJECT TERMS

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